

United States District Court
for the Western District of Oklahoma

Richard Glossip, *et al.*,
Plaintiffs,
v.
Randy Chandler, *et al.*,
Defendants.

No: 14-cv-665-F

EXPERT REPORT OF ERVIN YEN, M.D.

1. My name is Dr. Ervin Yen. I am and have been a practicing anesthesiologist in Oklahoma City for over 36 years. I graduated from the University of Oklahoma (O.U.) College of Medicine in 1981 and finished my residency in anesthesiology at the O.U. Health Sciences Center in 1984.
2. Since 1984, I have worked in private practice with Anesthesia Scheduling Services, a group of independent physicians serving Oklahomans at hospitals throughout the Oklahoma City metro area. For around five years, from 1990 to 1995, I served as the president of the group. For nearly 20 years, I focused on cardiovascular anesthesiology. In the past, I had privileges and practiced at most of the major hospitals in Oklahoma. Now, I practice almost exclusively at St. Anthony Hospital in Oklahoma City.
3. I am a long-time member of the American Medical Association, the American Society of Anesthesiologists, the Oklahoma State Medical Association, and the Oklahoma Society of Anesthesiologists, among other organizations. I currently serve as the Oklahoma delegate to the American Society of Anesthesiologists, a position I have held for the past 10 years or so. From 2008 to 2009, I served as the President of the Oklahoma Society of Anesthesiologists. From 1997 to 1999, I served as the Chief of the Anesthesiology Section at St. Anthony Hospital. The views expressed here, however, are my own and not those of any employer, group, or organization with which I work or affiliate.

4. In 2014, I became the first physician in four decades to be elected to the Oklahoma Senate. Representing the 40th District, I served as the Chairman of the Senate Health and Human Services Committee until 2018. In 2019, after my legislative service ended, I received the American Medical Association's Dr. Nathan Davis Award for Outstanding Government Service for my "dedication to improving public health."
5. I have been asked by Defendants to provide my expert medical opinion, and the basis for that opinion, on: (1) the efficacy of the three drugs making up the State's current execution protocol, especially focusing on midazolam; and (2) the quality of various medical aspects of the protocol itself. For this endeavor, I am being compensated in the amount of \$1,500.00 per day of live testimony, whether at deposition or in trial. I am also being compensated \$250.00 per hour for the time I spend preparing for said testimony. My compensation is not dependent on my opinions or on the outcome of this litigation.
6. The following opinions are based primarily on my nearly four decades of actively practicing anesthesiology, and in particular on my extensive hands-on experience with the drugs used in Oklahoma's execution protocol like midazolam.

Effects of a 500 mg dose of Midazolam

7. Midazolam is a benzodiazepine. Benzodiazepines are sedatives and include diazepam (Valium), chlordiazepoxide (Librium), and alprazolam (Xanax). As the plaintiffs in this case acknowledge in their complaint, midazolam "is a central nervous system [CNS] depressant." (para. 60). This means that midazolam decreases brain and nervous system activity. Different CNS depressants work in different ways to decrease brain activity. Midazolam works by increasing the effect of a brain chemical called GABA (gamma amino butyric acid) which produces a calming effect on the brain. Charles E. Griffin, et al, "Benzodiazepine

Pharmacology and Central Nervous System-Mediated Effects,” The Ochsner Journal 13:214-223, 214 (2013).

8. Midazolam is used and has been used clinically to decrease anxiety, to induce general anesthesia, to decrease the incidence of recall under sedation and anesthesia (*i.e.*, to cause amnesia), to help patients avoid being conscious of pain, and, along with neuromuscular blocking agents, to intubate patients rapidly. I have used from 2 to 20 mg of midazolam, on thousands of patients, and for all of these reasons, during my long career. At present, I typically use 5 to 10 mg of midazolam to sedate several patients per week and help them not be conscious of pain and not remember any experience of a procedure. Simply put, I have extensive past and current experience with midazolam.
9. In addition to assisting patients with avoiding pain and anxiety, it is my medical opinion that midazolam alone can induce general anesthesia. Indeed, the package insert for IV midazolam in my office says it can be used for “induction of general anesthesia” and lays out the process for doing so: “In the absence of premedication, an average adult under the age of 55 years will usually require an initial dose of 0.3 to 0.35 mg/kg for induction [of general anesthesia], administered over 20 to 30 seconds and allowing 2 minutes for effect.” Although the insert also says midazolam may be or is generally used “before administration of other anesthetic agents,” the insert clearly approves of the use of midazolam alone to *complete* induction of general anesthesia: “If needed to complete induction, increments of approximately 25% of the patient’s initial dose [of midazolam] may be used; induction may instead be completed with inhalational anesthetics.”
10. Similar statements can be found in other sources. Robert K. Stoelting’s textbook “Pharmacology and Physiology in Anesthesia Practice” (1987 ed.) says clinical uses of

midazolam include “induction of anesthesia” at a dose of 0.2 to 0.3 mg/kg (page 128). “The Complete Drug Reference” from Martindale (36th ed.) says that one of the “main[]” ways midazolam is used is “for induction of general anaesthesia,” and that “[w]hen given intravenously as an anaesthetic induction agent, anaesthesia is induced in about 2 to 2.5 minutes” (page 1009). In a 1997 review of midazolam in *Pharmacology in Emergency Medicine*, Sean Patrick Nordt and his co-authors stated that midazolam’s “clinical use is primarily reserved for conscious sedation and induction of general anesthesia” (page 360). The current online Encyclopedia Britannica entry for “Anesthetic” and “General Anesthetics,” which was written by Floyd E. Bloom, the Chairman of the Scripps Research Institute Department of Neuropharmacology, states that “Rapid, safe, and well-controlled anesthesia can be obtained by the intravenous administration of depressants of the central nervous system, such as the barbiturates (e.g., thiopental), the benzodiazepines (e.g., midazolam), or other drugs such as propofol, ketamine, and etomidate. These systemic anesthetics result in a rapid onset of anesthesia after a single dose, because of their high solubility in lipids and their relatively high perfusion rate in the brain. ... Unconsciousness occurs smoothly within 10 or 15 seconds of starting the injection.”

11. I have actually used midazolam alone to induce general anesthesia, although probably not since early in my career, because at induction doses, it makes patients stay unconscious for too long. Again, to quote the package insert for IV midazolam, “In resistant cases, up to 0.6 mg/kg total dose may be used for induction, but such larger doses may prolong recovery.” I have colleagues who have used midazolam for induction of general anesthesia as well, and I would consider using it now for inducing general anesthesia in certain relatively rare scenarios. For example, I might use midazolam to induce general anesthesia with a patient who has low blood

pressure issues, since midazolam tends not to make blood pressure plummet like many of the other IV induction agents we use.

12. At times when administering midazolam, during sedation cases for example, I have utilized a Bis bispectral analysis device (Aspect Medical Systems) to help monitor the depth of a person's anesthesia. The Bis device measures the minute electrical impulses from the brain which reflect brain wave activity, and the monitor reads a single dimensionless number of zero to 100. A reading of 100 indicates the patient is fully awake, and a reading of zero indicates there is minimal or no brain wave activity. The Bis device is not mandatory or critical for anesthesiology practice like a pulse oximeter is, but it still can be useful. Here, it can provide a simple and helpful framework for understanding the operation of a drug like midazolam.
13. In my experience, after 5 mg of midazolam and no other IV medications, the Bis reading usually goes from around 100 to somewhere around 70 to 80. At this level, the patient might or might not be unconscious, and might or might not move in response to a stimulus like a scalpel, but in any event the patient is likely not experiencing any discomfort or having any recall afterward. General anesthesia, where the patient is unconscious, usually correlates with a reading of 40 to 60 according to the Bis monitor. While I have never utilized 500 mg of midazolam, I am confident based on my experience with up to 20 mg of midazolam that such a dose would cause the Bis reading to plummet below 70 and well into the range indicating general anesthesia. My experience has always been that the more midazolam I give a patient, the lower the Bis reading goes.
14. In my experience, midazolam takes effect within minutes and frequently its effects can be seen within seconds. And because of its half-life, midazolam has a long duration of effect compared with propofol or barbiturates. As such, anesthesiologists do not usually use higher doses (20+

mg) of midazolam for surgery, because at such doses, the patient would not be arousable for an excessive period after the surgery has ended. Stated plainly, you are not going to be able to wake up a person who is unconscious from higher doses of midazolam quickly or easily without giving additional reversal drugs to do so. Inhalation agents, propofol, and barbiturates typically have much shorter durations of action, and so they are used more often for surgery.

15. After a 500 mg dose of midazolam, it is my medical opinion that a person would quickly (within seconds) become unconscious. In addition, based on my experience, I believe that person would be insensate to pain (*i.e.*, unable to feel pain) after such a large dose and be in a surgical plane of anesthesia and may even be comatose until the moment of death. Even if the person somehow didn't die from that much midazolam, at that high dosage the anesthesia and inability to perceive pain would last several hours.
16. The plaintiffs' complaint in this case states that "midazolam is a central nervous system depressant that produces sedative, hypnotic, muscle relaxant, anxiety inhibitory, and anticonvulsant effects" (para. 60). In other words, the plaintiffs admit that midazolam decreases brain activity and the function of the central nervous system, both of which are necessary for the transmission of and awareness of pain signals in the nervous system. With that concession, it is difficult for me to see how the plaintiffs can argue that a massive 500 mg dose of midazolam would not succeed in achieving, at the very least, a deep sedation and highly decreased awareness of pain, if not general anesthesia and total unawareness of pain. At 500 mg of midazolam, I would anticipate the person would not feel pain from anything injected afterward nor would the person perceive noxiousness from any other stimulus afterward. Certainly, there would be no perceived pain from the second and third drugs in Oklahoma's current protocol after the inmate received 500 mg of midazolam.

17. Nor would anything in the execution protocol given immediately after the 500 mg of midazolam raise a person's consciousness. There is a drug that is used to reverse the effects of midazolam, called Flumazenil, but it is not a part of Oklahoma's execution protocol. I have never heard of vecuronium bromide or potassium chloride raising a person into complete consciousness after being rendered unconscious by a central nervous system depressant, nor would anything in those drugs chemically counteract midazolam or its effects on the central nervous system.
18. It is possible that midazolam has a ceiling effect. But I am not aware of any scientific study showing at what dose, or at what level of unconsciousness, that ceiling effect (if any) occurs. Personally, I have never witnessed a ceiling effect during my many uses of midazolam.
19. As for me, 20 mg is the most I ever recall giving a patient, but it is quite possible I have given 30 mg to a patient over several hours of surgery during my decades of practice. I typically administer midazolam during heart surgery, both to make recovery a little bit smoother and to give me an assurance that the patient would have no recall during certain parts of the procedure.
20. Acute pulmonary edema occurs where fluid builds up in the tiny air sacs of the lungs or the spaces between them, sometimes due to an obstructed airway (by the tongue, pharyngeal tissue, etc. similar to what happens with sleep apnea) or more frequently, due to an acute heart problem with the heart muscle or a heart valve. Chronic edema can be caused by pneumonia, exposure to certain toxins and medications, trauma to the chest wall, and traveling to or exercising at high elevations. That build-up of fluid can then interfere with oxygen entering the bloodstream. With the airway obstructive type, the patient is physically trying to suck air in, but their airway is blocked, so the sucking creates negative air pressure, which causes fluid to infiltrate into the lungs. I have seen this acute pulmonary edema a handful of times, clinically, but I have never seen, nor heard of acute pulmonary edema resulting from an injection of

midazolam.

21. Even if acute pulmonary edema were to occur from 500 mg of midazolam somehow, it is highly likely to occur a number of minutes after the injection and well after the person loses consciousness. This is basic physiology. In an IV injection, the drug typically reaches your brain in about 30 to 45 seconds, and that is when unconsciousness is going to ensue. The earliest you almost always see acute pulmonary edema, on the other hand, is over the course of several minutes. Finally, I have certainly never seen (nor would I anticipate) any kind of pulmonary edema causing a person to regain consciousness after being unconscious from a central nervous system depressant.
22. Involuntary movements under anesthesia (including with midazolam) are relatively common. They could be the body automatically responding to noxious stimuli, but that movement says little about a person's *consciousness* of that pain or sensation. Gross purposeful movements could mean a patient's anesthesia needs to be deepened, whereas reflex movement in response to some stimulation does not. Any and all anesthesiologists would say that involuntary movements are common under general anesthesia.
23. In my practice, patients move during surgery all the time. Many of my patients are unconscious but spontaneously breathing which, of course, is movement. Also, we might see a gag reflex when a breathing tube is inserted or removed, a cough, or the patient might jerk suddenly, among other movements. If the movement is interfering with the work of the surgeon, we might deepen the IV anesthetic or inhalation agent. Similarly, too much movement might cause us to check vital signs including blood pressure and heart rate, or the Bis monitor, to see if the anesthetic needs to be deepened or more neuromuscular blocking agents are needed. But if the Bis monitor reading is low, and no other red flags exist, then I am certain the patients are

unconscious and not feeling pain.

24. In their complaint, the plaintiffs put forth a number of examples of inmates allegedly moving during executions with midazolam (para. 68). But even assuming the instances relayed are true, and accurately recorded or remembered, the specific movements such as coughing, heavy breathing, lips moving, and even generalized body jerking are not particularly uncommon in my experience for patients under general anesthesia. It is also possible that the cause of some of these movements, especially the ones related to breathing, is midazolam's ability to depress respiration (*i.e.*, slow or stop breathing) when given in larger doses. This is not worrisome in the execution context, however, because the inmate would already be unconscious and unable to sense pain before their respiration was depressed to any significant degree, the depression would not wake them up, and the end goal of the execution is to stop the breathing.
25. In my opinion, an analgesic such as fentanyl prior to injection of 500 mg of midazolam would not reduce pain during an execution that culminates with potassium chloride. This is because, again, the 500 mg of midazolam will quickly render the person deeply unconscious and there will be no pain experienced afterward. Not even the IV injection of potassium chloride, which can cause discomfort at the IV site in conscious patients, would raise any concerns because of the rapid and potent effect of the midazolam. Analgesics are used during surgery frequently with clinical doses of midazolam or other anesthetics, but that in part is to reduce the level of pain a patient feels *after* they regain consciousness following the surgery, which is obviously not a concern for an execution.

Evaluation of Oklahoma's Lethal Injection Protocol

26. In my opinion, the medical professionals listed in Oklahoma's current lethal injection protocol—whether it be a physician, physician's assistant, nurse, etc.—are qualified to carry out the tasks

they are assigned. The expertise of someone like an anesthesiologist is not needed for carrying out executions, given the qualifications of the potential team members as well as the protocol in place. This is in part because of the nature of the task itself. An execution in effect involves an intentional overdose of a drug, and it is relatively easy to carry out an overdose. Sadly, laypeople manage to do it to themselves all the time and in the past frequently used diazepam (Valium) which is a benzodiazepine. Anesthesiologists are more needed when one has to determine the correct type and precise amount of drug, based on a person's many physical characteristics and the procedure at issue, that would allow the physician to bring the person back to consciousness without any harm or recall whatsoever. But again, that is not the point of an execution.

27. Typically, one would check the depth of a person's anesthesia by observing the vital signs and observable indications (blood pressure, heart rate, changes in pupil size, eyelid reflexes, and sweating), the dosage of the medications given (whether IV, oral, or inhalational), movement by the patient, and sometimes the Bis monitor or other such devices. A patient experiencing severe pain would most likely have large increases in blood pressure and heart rate. If a patient is speaking, they are at a lighter level of anesthesia, although they may not have any recall of that period in time.
28. I believe the medical professionals listed in the protocol are generally able and qualified to determine whether the inmate is rendered sufficiently unconscious, using these methods and others. A physician is obviously qualified, and physician's assistants and nurses frequently sedate patients (under a physician's order) and use such monitoring techniques to make sure the patient is at the appropriate consciousness level. Indeed, a nurse's duties include regular "neuro checks" on their patients.

29. The easiest way to make that type of consciousness determination would be to ask the inmate to make a voluntary movement. If the inmate does not make any movement, since the muscle relaxant has not been given, they are unconscious. Five minutes should be sufficient time to wait before performing the consciousness check, since the midazolam will induce unconsciousness within 1 to 2 minutes based on my experience in the operating room.
30. In my view, the most difficult part of the execution, to the extent any part is medically difficult, is the IV placement. But while anesthesiologists and other physicians are qualified to place an IV or even a central line, they are not needed, since other healthcare professionals place such lines every day in various healthcare settings. In other words, all the medical professionals listed in the protocol are qualified to establish the IV lines set forth in the protocol. The protocol for setting proper IV lines is very similar to what we use in clinical settings. Frequently, the ante-cubital (between the upper and lower arm) site is used clinically and an ultrasound device is used to locate an appropriate vein. A backup IV is also certainly sometimes utilized clinically as well as alternative sites. The protocol for monitoring the proper functioning of the IV lines is also similar to what is done clinically. I believe the protocols for setting and monitoring the IVs are adequate.
31. In clinical practice, we try to have the IV site in a visible location, but that is frequently not possible. If visible, we look for signs of infiltration, such as swelling or coldness at the site. If not visible, we pay attention to how the IV fluid is dripping at the drip chamber. Sometimes, we might need to remove the surgical drapes in the middle of a surgery to inspect the IV site. The person utilizing the IV, whether for fluids, medications, or blood products is the one monitoring the functioning of the IV.
32. I do not see any issues with the use of vecuronium bromide in this method of execution. I

would anticipate a person given this dose of midazolam (500 mg) would likely not exhibit any significant or worrying involuntary movements once the full dose is administered because of how deep they would be aesthetized. (In my experience, the more anesthetic we use, the less involuntary movement we see.) Once the vecuronium takes effect, chances of involuntary movements would be further reduced because it in essence stops all muscle activity (except that of the heart). The paralytic would also have the effect of stopping respiration, but that would already be in process after the midazolam takes effect. In my experience, this cessation of respiration is what happens when people overdose on diazepam (Valium), which is a benzodiazepine like midazolam.

33. Paralytic drugs like vecuronium are frequently used for surgery where muscle relaxation is needed (as in intra-abdominal surgery). I used vecuronium (after pancuronium became unavailable) on my patients for coronary artery bypass surgery at a dose of 20 to 30 mg per surgery, until it became unobtainable about 15 to 20 years ago. I now use cis-atracurium and rocuronium which both have significantly shorter durations of action.
34. The primary risk of paralytics like vecuronium is paralysis after the surgery is over since it has a significantly longer duration of action than other paralytics. That means the patient might need to be intubated and on the respirator for a significant period of time after the procedure is over. That is why we use different paralytics with different durations of action for different lengths of surgery, although sometimes the paralytics can be reversed with certain reversal drugs.
35. Paralytics in combination with midazolam or other drugs such as propofol are frequently used for emergency intubation of patients with life-threatening respiratory difficulties. Receiving a paralytic without any anesthetic medication (midazolam or something else) to render them unconscious would be unpleasant. That person would feel paralyzed, but be awake.

However, I have actually given a patient a paralytic without any sedation when I feared they were about to die from lack of oxygen due to a respiratory problem. Invariably, those patients have no recall of the paralysis and intubation, because they are unconscious from hypoxia (*i.e.*, a lack of oxygen).

36. When carrying out death by firing squad, death could occur very quickly, especially if the firing squad aims for the head. But it is my understanding that the firing squad typically aims for the chest. That would mean the inmate would have brain activity for seconds and perhaps even more than a minute, during which they would be suffering from pain in their chest, as well as a feeling of suffocation while their brain becomes hypoxic. The inmate gets shot in the heart, the blood stops pumping, but the brain keeps working for a while, in other words. The persons I have treated with gunshot and stab wounds to the chest are experiencing pain and suffering, unless they have received medications prior to my intervention. One New Year's Eve many years ago, I anesthetized a patient who had a screwdriver in his chest and into his heart. He was 36 years old, survived, and actually did quite well. Point being, in my view the odds of an inmate experiencing pain and suffering are greater from being shot in the chest than with a midazolam injection, followed by a paralytic and potassium chloride.

Conclusion

37. I am not going to say I am for or against capital punishment. My understanding is that the majority of Oklahomans are for it. It is currently legal in our state. Thus, my view is that the state should carry it out in a way that is not cruel. I believe that the current midazolam protocol sufficiently and appropriately minimizes the pain and suffering associated with death.

38. I hold all my opinions with a reasonable degree of medical certainty.

39. I reserve the right to expand, modify, or otherwise amend my opinions as appropriate.

40. I declare under penalty of perjury that the foregoing is true and correct.

Executed on January 15, 2021.

s/ Ervin Yen
Ervin Yen, M.D.

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CURRICULUM VITAE for

Ervin Yen, M.D.

608 NW 9th St, Suite 6210

OKC, OK 73102

(405) 272-9641

Date of Birth: December 14, 1954

Professional Experience: Private practice, Anesthesiologist in Oklahoma City, OK, 1984 - present

Education:

Anesthesiology Residency, University of Oklahoma Health Sciences Center, Department of Anesthesiology, 1981 - 1984

M.D., University of Oklahoma College of Medicine, 1981

B.S., Zoology, University of Oklahoma, 1977

Licensure: Oklahoma Medical License # 13723 issued 1982

Memberships:

American Society of Anesthesiologists

Oklahoma Society of Anesthesiologists

American Medical Association

Oklahoma State Medical Association

Oklahoma County Medical Society

Offices:

Oklahoma State Senate District 40 (Northwest Oklahoma City), 2014 - 2018

Chairman, Oklahoma Senate Health and Human Services Committee, 2016 - 2018

President, Oklahoma Society of Anesthesiologists, 2008 - 2009

Chief, Anesthesiology Section, St. Anthony Hospital, Oklahoma City, OK, 1997 - 1999

President, Anesthesia Scheduling, Inc. (12 member group of private practice Anesthesiologists in Oklahoma City), 1990-1995

Co-Chairman, Oklahoma Patients Coalition, 2010 - present

Oklahoma State Delegate, American Society of Anesthesiologists, 2010 - present

Awards:

American Medical Association 2019 Dr. Nathan Davis Award for Outstanding Government Service as a state legislator

Oklahoma State Medical Association 2019 Ed Calhoon, M.D. Leadership in Medicine Award

Oklahoma State Regents for Higher Education 2018 Distinguished Service Award

The University of Oklahoma College of Medicine 2018 "Friend of Medicine" Award

Oklahoma State Medical Association 2017 Ed Brandt, Jr., M.D. Outstanding Elected Official Award

Hospital Privileges:

St. Anthony Hospital

Publications:

"Rapid Cannulation of the Coronary Sinus during Port Access Cardiac Surgery", Ervin Yen, M.D. et al.

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